

Emissions from Distributed Generation

April 20, 2000

California Energy Commission

Siting Committee Workshop

Evaluating Distributed Generation CEQA and Permit Streamlining



Sheryl Carter
71 Stevenson Street, Suite 1825
San Francisco, CA 94105
(415) 777-0220
Scarter@nrdc.org

Distributed Generation Emissions Data

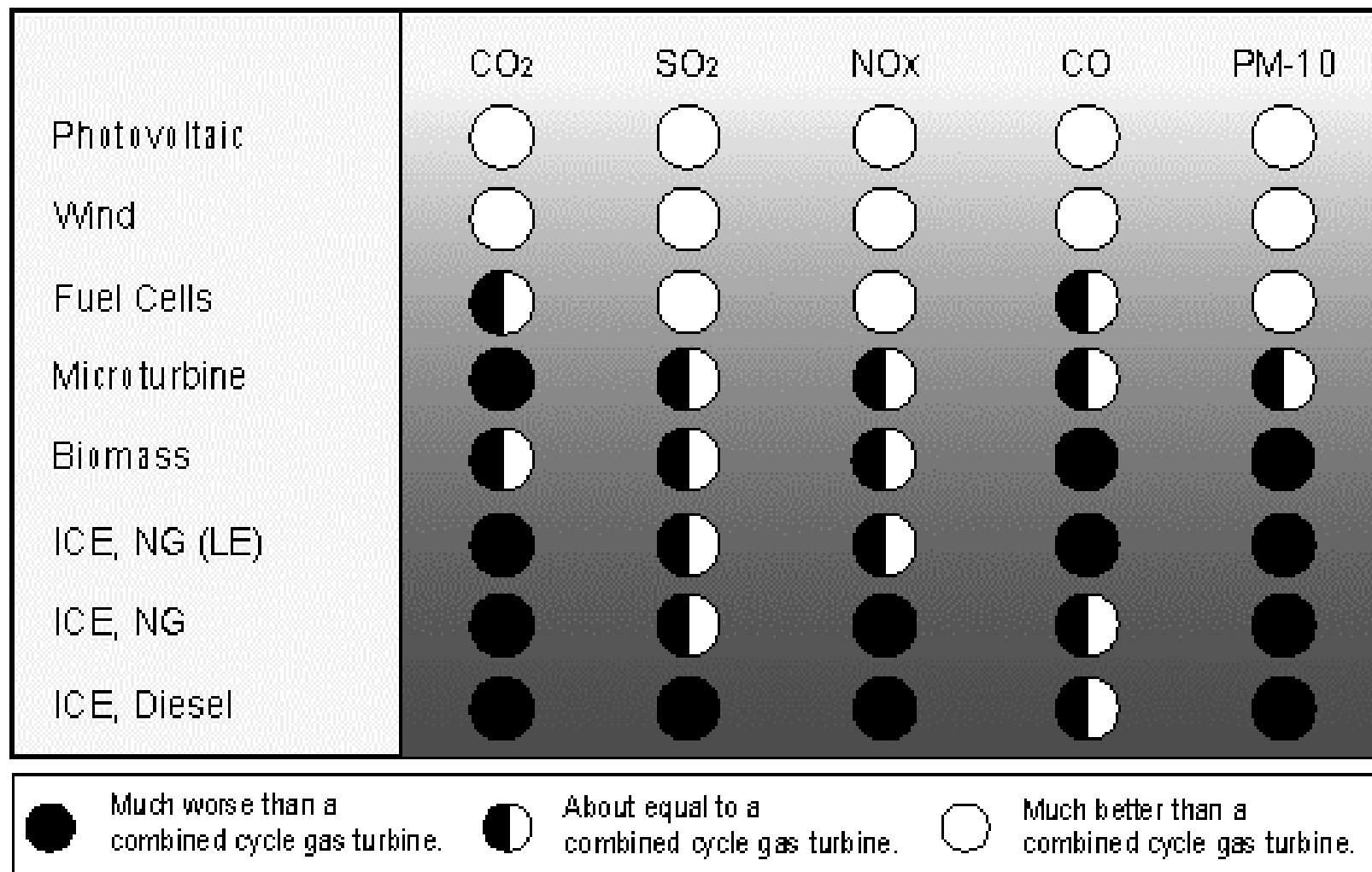
Emissions for uncontrolled electric generators sized under 1 MW ^a								
Device type	Fuel	Specific cost	Eff.	Emissions in lb/MWh ^b				
		\$/kW ^c	% at HHV ^d	CO ₂	NO _x ^e	SO ₂ ^f	CO ^g	PM-10
ICE ^g	diesel	300 - 1,000	33-42	1,300-1,700	10-41	0.4-3	0.4-9	0.4-3
ICE, stoic ^g	NG	300 - 1,000	33-42	950-1,200	18-53	negl.	1-6	~0.6
ICE, LE ^g	NG	500 - 1,200	35-41	980-1,100	0.3-6.0	negl.	2-9	~0.6
Microturbine	NG	650 - 850	22-30	1,300-1,800	0.2-1.4	negl.	0.3-1.8	>0.03
Fuel Cell	H from NG	3,000 - 4,000	29-50	800-1,400	<0.05	0	0.01-0.12	negl.
Biomass ^h	gas/wood	tbd	30-41	0-2,300 ⁱ	0.3-6.0	<0.3	2-9	0.6-4
Photovoltaic	sunlight	5,000 - 12,000	n/a	0	0	0	0	0
Wind	wind	850 - 3,500	n/a	0	0	0	0	0
New CC Turbine ^j	NG	500-870	48-57	700-830	0.11-0.9	negl.	0.05-1.0	0.03-0.3
				770-920	0.13-1.0	negl.	0.05-1.1	0.03-0.3

Notes

- a) Data are limited to products currently on the market or expected to be on the market by 1/1/03; wood-burning biomass may be an exception.
- b) All values are rounded to one or two significant figures.
- c) Cost of distributed generation equipment is does not include emissions controls.
- d) Percent efficiency, measured with respect to the fuel's higher heating value.
- e) Combustion can often be tuned for either low NO_x or low CO emissions, thus it is unlikely that uncontrolled combustion equipment will achieve the low end of the ranges presented for both these pollutants.
- f) Sulfur is present in natural gas at 0.0006%, but is assumed to be 0 for fuel cells due to filtering. Sulfur in diesel is assumed to range from 500 ppm for road fuel to 3000 ppm for non-road fuel.
- g) "ICE" means internal combustion engine. "LE" means tuned for low emissions. "Stoic" means stoichiometric which is the standard tuning.
- h) Biomass ranges are equal to those for a LE ICE extended as appropriate to include emission levels from fluidized-bed combustion of dry wood.
- i) 0 is the theoretical minimum when accounting for fully renewable biomass.
- j) Central generation reference condition. >100 MW new combined-cycle turbine with at least steam-injection NO_x control.

*Source: "Small and Clean is Beautiful: Exploring the Emissions from Distributed Generation and Pollution Prevention Policies," by Nathanael Greene & Roel Hammerschlag, to be published in the *Electricity Journal*, June 2000*

Comparison of Uncontrolled Distributed Generation Emissions Relative to Combined Cycle Turbines



Source: "Small and Clean is Beautiful: Exploring the Emissions from Distributed Generation and Pollution Prevention Policies," by Nathanael Greene & Roel Hammerschlag, to be published in the *Electricity Journal*, June 2000